tionalities, and there are various instructive notes. Stimulation is provided, for example, by the inclusion of some simple pseudo-elliptic integrals, and those who are familiar with Abel's theorem will see frequent traces of its application. Practical ends are served by the inclusion of Simpson's rule and the theory of the planimeter, and a sufficient number of examples for practice is given throughout.

The actual limits of the table are best seen from the section on definite integrals. Here we have, for instance, $\int_0^\infty e^{-ax} \cos bxdx$, but not $\int_0^\infty \sin ax.dx/x$. From his position at Cambridge, Mr. Bromwich has no doubt been able to fix the line at the most appropriate place; in a table of this sort it is not very easy to decide where to stop.

G. B. M.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Value of the "External" Degrees of the University of London.

It is often the case that a system, whether of Government or of social custom, passes muster until its shortcomings are brought to light by some specific instance of hardship or injustice. The reform introduced in the constitution and government of the University of London, due to the report of the Commissioners of 1898, was devised to remedy alleged shortcomings in the system of awarding degrees on examinations alone; and the "internal" side of the University was then constituted, in which the teachers were given considerable (but in the opinion of the writer, insufficient) control over teaching and examinations. In spite of the fact that purely "external" examinations (*i.e.* examinations in which the teacher takes no part) were unknown, save in London, in China (the system has since that time been altered there), and in New Zealand and in India (the latter two countries having copied the system in vogue in the University of London), it was resolved that this "external" system should be continued; it has ever since formed one of the divisions of the University.

It is a matter of common knowledge that this course has not made either for peace or for efficiency; and at the present moment Lord Haldane's commission is reconsidering the whole question of university education in London. It is rumoured that their decision may involve complete separation of the "internal" and "external" sides of the university. I wish here to give reasons why the "external" side of the university should not be perpetuated, and I base them upon an instance where flagrant injustice has been done to a late student of University College, Mr. F. P. Burt, whose permission I possess to make known the facts connected with his candidature for the D.Sc. degree in chemistry.

At a meeting which took place some years ago of representatives of the Sorbonne (the University of Paris) and of the University of London, I, among others, was asked to give a short address. I ventured then to point out that out of 100 candidates for an external examination, 25, on an average, were undoubtedly "passes"; 25, equally indisputably failures; but as regards the remaining 50 it was a matter of good luck if they passed, or of bad luck if they failed. I suggested that as an excuse for persistence in a system involving such haphazard results the well-known gambling spirit of the English was satisfied; they like to take a risk of the kind.

My remarks may have been somewhat exaggerated; I will not insist on the proportions; but it is indubitably the case that no proper judgment can be formed on the fitness of a candidate to pass which is based solely on the verdict of external examiners reading written papers. The number of candidates at such examinations is very large; the physical strain to the examiner in reading and "marking" hundreds of papers in a comparatively short time is immense, and with the best will in the world he cannot act fairly. I speak from ample experience, both in London and elsewhere.

For higher degrees, such as the Doctorate, it is within the discretion of the Senate to appoint examiners *ad hoc*, for it is not to be expected that the official examiners shall always be able to form an accurate judgment on the matter of a thesis of a special nature. This, however, the Senate does not always do on the "external" side; on the "internal" side, the services of a special examiner are rarely, or never, dispensed with.

While in 1858, when the degrees of the University of London were thrown open to all applicants, solely on an examinational test, with no restrictions (except in the faculty of medicine) as to how they had acquired their knowledge, some excuse might have been found for this course; but the spread of education, and the existence all over the country of teaching institutions where advanced instruction may be obtained, and in many cases where degrees are awarded, has rendered it practically unnecessary to provide for the "private" student. Indeed, in the faculty of science at least, very few students present themselves for examination who have not received training at some public institution, and many of them have received degrees elsewhere.

Mr. F. P. Burt, whom I mentioned before, was a student in University College, Bristol. He subsequently prosecuted a research, begun there, in the laboratories of University College, London. Having completed this research, he sent it to the University as an *external* student, without having consulted any members of the London staff. My position in connection with him is therefore merely that of an outside member of the public; I am in no way responsible for his thesis.

This thesis was received by the University last spring, and Mr. Burt was informed by the University authorities that it had not been accepted as qualifying for the degree. To those who knew the work, the refusal was so extraordinary that I sent copies of the thesis, which dealt with the atomic weights of nitrogen and sulphur, to three gentlemen, one of whom is a member of the International Commission on Atomic Weights, who publish an annual table, printed in all the leading chemical journals, stamped with their authority. It is their function to read and examine critically all the work on the subject done during each year, and to assign a value to it in drawing up their table of these constants. This gentleman, Prof. Ostwald, late of Leipzig, is, it may be taken, particularly qualified to judge of such work as that of Mr. Burt. The second referee was Prof. Th. W. Richards, of Harvard University, well known for his work on atomic weights; and the third, Prof. Guye, of Geneva, who has special experience of the kind of work done by Mr. Burt, and who is also a leading authority. I now give a translation of Prof. Guye's letter; he is himself a graduate of Paris:—

"*Geneva, June* 22, 1911.

"Sir William Ramsay has called my attention to the researches of Mr. Burt. I was already acquainted with them, through having followed them closely as they appeared. A fresh study of them has confirmed me in the opinion that they place Mr. Burt among the small number of experimenters capable of carrying out satisfactorily chemical researches of high precision. This opinion is derived from his researches on helium and neon, and on those on sulphide of nitrogen; they present very great experimental difficulties, which have been admirably surmounted, so much so that they form a very important contribution to the recent determinations of atomic weights. Work of this kind ought to be greatly encouraged, for it forms a particularly stable foundation in fixing the values of atomic weights. I hold the opinion that the memoir on the ratio of N to S would assuredly be accepted as a thesis for the doctorate in Swiss and in French universities.

"(*Signed*) PH. A. GUYE."

Prof. Ostwald also wrote a letter, of which the following is a translation:—

"*Gross Bothen, Saxony.*

"The collected works of Mr. F. P. Burt show him to be an experimenter who knows what to aim at and how to arrive at results. He appears to be already sufficiently mature to occupy a position which demands the services

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of an independent investigator. Had his work 'On the Relative Atomic Weights of Nitrogen and Sulphur' been presented in Leipzig, I should gladly have accepted it, not only as a doctor's dissertation, but also as a sufficient qualification for the position of university lecturer (Privatdozent).

"(*Signed*) WILHELM OSTWALD."

Prof. Th. W. Richards wrote:—

"The investigations of Mr. F. P. Burt seem to me to present many points of interest, and to indicate a high order of experimental ability. In view of the fact that a large proportion of the work was done by Mr. Burt himself, even when he was assisted by collaborators, the sum total of his papers appears to me to present more than the equivalent of a thesis for the doctor's degree in the best universities in America. It must be remembered, however, that a thesis is only a part of our requirement.

"(*Signed*) THEO. W. RICHARDS."

Copies of these letters were sent to the Senate of the University of London in July, 1911, together with a letter, the last sentence of which is:—"Since it appears to me (and my opinion is shared by Profs. Dixon and Collie) that an error of judgment has been made in Mr. Burt's case, we would respectfully urge you to reconsider his claims."

On October 18, 1911, the Senate passed the following resolution:—

"That, having considered the communication from Sir William Ramsay of July 10, 1911, and having heard a report from the examiners, the Senate are not prepared to vary the decision at which they have arrived."

As it was impossible to believe that the Senate attached more importance to the decision of their examiners on the merits of the thesis than to the verdict of special experts, the inference was obvious that they considered that the work, or a sufficient proportion of it, had not been done by the candidate. Perhaps this view was partly justified by the terms in which Mr. Burt had thanked all those to whom he supposed himself indebted during the progress of his research; his expressions were, to say the least, generous.

The Regulation for External Students (Blue Book, Univ. of Lond. Calendar, p. 294) is:—"If the Dissertation or Thesis be approved by the Examiners, the Candidate shall be required to present himself . . . to be further tested either orally or practically, or by printed papers, or by all these methods. . . ." But in certain circumstances the candidate may be exempted.

It was therefore within the powers of the examiners to have interviewed the candidate, to have asked him the nature of the assistance which he acknowledged, and to have obtained from him the names of the persons assisting him, and, should his word have been doubted, to have written to them inquiring as to the extent and nature of the help given. This was not done. Hence it appeared necessary to obtain from all those who knew of Mr. Burt's research testimony as to the share they had had in it. Prof. Travers, Prof. Usher, Prof. Francis, and Dr. Whytlaw Gray all testified most emphatically that the share which they had borne in the work was insignificant, and that the work was in every sense of the word original. Prof. Dixon, in whose laboratory Mr. Burt is now assistant, although not having been in contact with Mr. Burt during the progress of his thesis research, voluntarily wrote to me expressing the opinion that work in which Mr. Burt is at present engaged is being done "in a masterly manner," and that he has "no doubt as to the capacity, manipulative skill, foresight, and patience which Burt possesses to carry out such work."

Copies of these letters were sent to the Senate on November 27, 1911, and they were again requested to reconsider their decision not to admit Mr. Burt "to be further tested." On January 25, 1912, the Senate resolved:—"That the Senate decline to reopen the question of the rejection of the D.Sc. candidate referred to."

After this final refusal no course remains but to make public the facts of the case. And this I do, not so much in justice to Mr. Burt, but in order to raise the much larger question as to whether it is proper that a system in which such injustice can be perpetrated should continue to exist. I am led to understand that complaints are not infrequent that candidates of undoubted merit, not only in the faculty of science, but in other faculties, have had their theses rejected without sufficient reason. There is one instance, at least, of a thesis which, after summary rejection, was subsequently published in book form, and which received the highest encomiums from the Press and from private persons of eminence in the subject treated. On the "internal" side of the University I am unaware of any complaint having been made, for much more care is bestowed; and besides, the teachers, who are also examiners, are acquainted with the candidates' abilities from frequent personal communication, and often from daily contact.

There can be no doubt that such miscarriages of justice are to be attributed, at least in part, to the growth of the University. With few candidates some sort of acquaintance on the part of the examiners with their merits is possible, but with increase of numbers control becomes impossible. Moreover, there is a growing reluctance on the part of men of established reputation to accept the post of examiners; the work is hurried, it is badly paid, and it is a thankless task. The fact is that the day of "external" examinations is past; the system is an anachronism; and I think that the case which has been presented furnishes an irrefutable argument why that system should be abandoned. A degree is in essence a testimonial; and a testimonial from a corporate body depends for its value on the eminence of the persons capable of forming a judgment on the merits of the graduate and on their opportunities for forming a correct judgment. Where the examiners are not eminent, and where the opportunity of forming a judgment has not been given or has not been taken, the degree is worthless, and the corporate body awarding it should cease to exist.

W. RAMSAY.

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Are Eyes ever Autophanous?

THOSE who read Colonel Herschel's letter in NATURE of January 18 may be interested in some observations which I made during the summer upon the sight and eyes of cats. Whereas in men and monkeys the retina is backed by black pigment, as a photographer backs a plate when his camera is to be directed towards a window, in almost all other mammals it rests on a brightly burnished layer of cellular or fibrous tissue, the tapetum. It is this mirror which throws the light back to an observer who stands between the animal and the source of light. The eye is at the same time a camera focussed to form an image of the observer on its sensitive screen and a lantern focussed to project light upon the observer. Such an arrangement appears to a photographer fatal to the formation of an image sharp in line and dot.

Many explanations of the function of the tapetum have been offered, but none, to my thinking, satisfactory. To me it has long seemed that its only purpose can be to render the eye sensitive to movement, as distinguished from form. I studied my cats as they hunted field-mice. One of them would crouch for hours in front of a hedge. Seated at a moderate distance, I was able on several occasions to see the catch, a single spring in the direction of the mouse, whether it moved at the spot at which the cat appeared to be staring or considerably to one side or the other of the axis of her head. For movement her vision was perfect. If, as she roamed about the lawn, a daddy-longlegs shook a blade of grass, she sprang towards it. But to stationary objects she paid scant attention. In various places I fixed a dead mouse in as natural an attitude as I could make it assume with the aid of wires and wooden pegs. If the cat passed close to it she would stop to smell it, perhaps to pat it, but she never showed any sign of regarding it as something to be caught. In hunting for birds, on the other hand, her whole method was reversed. Cautiously climbing, she would study a dead leaf with the utmost care, afraid to move lest she should disturb a possible victim.

It seemed to me that the upper and lower halves of the retina functioned in different ways. I therefore examined the eyes of several cats. When perfectly fresh, the interior of the eyeball, seen under a dissecting microscope, is one of the most marvellously beautiful obects that can be conceived. The opalescent retina rests on a silver mirror

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